OLYMPIA BOWKER*

A Vague Invasion: The Inadequacy of Invasive Species Definitions in Reaching Federal and State Goals, Illustrated by Application of *Ammophilia arenaria* to Coastal Dune Preservation

* Olympia Bowker is a 2015 J.D./Masters of Environmental Law and Policy student at Vermont Law School. Ms. Bowker is pursuing dual Water and Land Use Law Certificates and is the Senior Notes Editor at the Vermont Journal of Environment Law. Prior to law school, she earned a B.A. in Environmental Studies and Geography at the University of Vermont. Ms. Bowker would like to thank Professor Kinvin Wroth and Emily Migliaccio for their judicious guidance and unfettered enthusiasm in the writing process.

INTRODUCTION

The definition of *invasive species* is not consistent between federal and state laws. Current invasive species legislation overwhelmingly harbors inadequate definitions and is unable to serve enumerated environmental objectives. The lack of congruency between federal and state laws results in inconsistent classification and treatment of certain species throughout the states and contradictory enforcement with regard to bio-remedial erosion management of coastal dunes. This is highly apparent with the treatment of *Ammophila arenaria*, commonly known as "European beachgrass," in Massachusetts and Oregon. Both states have high stakes in coastline conservation because of the high value of coastal property, the high percentage of U.S. population living on the coast, and the interest in ecological preservation. In addition, both states employ a myriad of erosion control techniques that vary in cost, efficacy, and feasibility. The origins of European beachgrass stem from Europe, and thus the grass is a candidate for invasive species classification and potential remediation. The federal, Massachusetts, and Oregon definitions and subsequent categorizations of invasive species are inconsistent, and this inconsistency results in an incompatible application of species prohibitions and remedial practices throughout these two coastal states.

Without defining a time or spatial scale for invasive species to make the statutes consistent, eradicating so-called invasive plants in certain areas and promoting growth in others would be arbitrary. In addition, biogeographic conservation efforts without proper scientific application of the term *invasive* to the federal definition are fruitless because they are preempted by federally captured economic incentives.

The purpose of this Article is to analyze the differences in federal and state definitions of *invasive species* and how those definitions further or fail to further the purposes behind controlling legislation. This Article also suggests ways to accomplish enumerated environmental goals with existing legislation by altering the definition of *invasive species*. This Article will first explore the ecology of coastal sand dunes and their potential economic impact on the states of Massachusetts and Oregon, along with types of erosion mitigation

techniques and their efficacy. Second, this Article will look at the purposes and efficacy of *invasive species* definitions in federal and state legislation. Next, this Article will apply each *invasive species* definition to European beachgrass, illustrating the discrepancy in application. Last, this Article will analyze the necessity of a concise, consistent, and scientifically accurate definition of *invasive* to promote and enforce uniform federal and state objectives behind invasive species legislation.

I
COASTAL EROSION PROCESSES AND THEIR ECONOMIC IMPACT

Coastal dune management is a vital part of the economic and environmental legacy of the United States.[1] Although coastline is "less than [ten percent] of the land mass of the United States, [in 1991] more than [seventy-five percent] of the population lived within fifty miles of coastal areas."[2] From 1970 to 2010, the population in the United States living in coastal shoreline areas increased by 34.8 million people—a thirty-nine percent increase.[3] In 2012 the United States Geological Survey (USGS) noted that the United States population continued to shift toward the shore where valuable coastal property is vulnerable to erosion.[4] Congress repeatedly recognized the "important ecological, cultural, historic, and aesthetic values in the coastal zone which are essential to the well-being of all citizens"[5]:

> Sandy beaches of the United States are some of the most popular tourist and recreational destinations. Coastal property constitutes some of the most valuable real estate in the country. Beaches are an ephemeral environment between water and land with unique and fragile natural ecosystems that have evolved in equilibrium with the ever-changing winds, waves, and water levels. Beachfront lands are

---

1 Ronald J. Rychlak, *Coastal Zone Management and the Search for Integration*, 40 DEPAUL L. REV. 981 *passim* (1991).

2 *Id.*

3 Nat'l Oceanic and Atmospheric Admin., *Communities: The U.S. Population Living at the* Coast, NOAA'S STATE OF THE COAST (revised Mar. 14, 2013), http://stateofthecoast.noaa.gov/population/welcome.html.

4 U.S. DEP'T OF THE INTERIOR & U.S. GEOLOGICAL SURVEY, NATIONAL ASSESSMENT OF SHORELINE CHANGE: HISTORICAL SHORELINE CHANGE IN THE HAWAIIAN ISLANDS 1 (2011), *available at* http://pubs.usgs.gov/of/2011/1051/pdf/ofr2011-1051_report_508.pdf.

5 16 U.S.C. § 1451(e) (2012); *see also id.* § 1452(2)(B) (announcing the congressional policy to encourage and assist programs to provide for "the management of coastal development to minimize the loss of life and property caused by improper development").

> the site of intense residential and commercial development even though they are highly vulnerable to several natural hazards . . . .[6]

Despite this articulation of the value of the coastline, it is important to note that the coastal zone is inherently unstable.[7] This instability is historical. Over twenty years ago, scholars recognized that "[b]each erosion is a chronic problem along most open-ocean shores of the United States."[8] In 1991, the Council of Environmental Quality (CEQ) estimated that twenty-four percent of the nation's 85,240 shoreline miles were "significantly eroding."[9] Erosion is a constant process and to effectively manage ever-shifting coastal processes, its nature and function must be understood.

A. Coastal Sand Dune Ecology

Coastal sand dunes protect landward development and act as a barrier to storm surges, waves, and flooding.[10] Coastal sand dunes also limit the effect of storm waves on land based coastal resources.[11] The protection offered by dunes is why coastal states have increased interest in dune management and rehabilitation.

In a cycle called "dynamic equilibrium," storms and waves remove sediment from the shoreline while wind returns sand to the dunes.[12] There are three essential requirements for this cycle: a prevailing onshore wind, a continuous supply of sand, and an obstacle to reduce the velocity of the wind to capture the sand being blown onshore.[13] Particularly during storms, coastal dunes erode and nourish the surrounding beaches and near-shore sand bars:

> Sand bars, beaches, and dunes interact within the larger coastal landform system, each exchanging sand while changing form and shape—an interaction that dissipates storm wave energy. As the storm diminishes and waves become less steep, nearshore sand bars migrate landward and weld onto the beach. Finer-grained sand is

---

6 U.S. DEP'T OF THE INTERIOR & U.S. GEOLOGICAL SURVEY, *supra* note 4, at 1.

7 J.M. Watson, *Coastal Change*, U.S. GEOLOGICAL SURV., http://pubs.usgs.gov/circ/c1075/change.html (last updated Aug. 4, 2008).

8 U.S. DEP'T OF THE INTERIOR & U.S. GEOLOGICAL SURVEY, *supra* note 4, at iii.

9 Rychlak, *supra* note 1, at 982.

10 Jim O'Connell, *Coastal Dune Protection & Restoration, Using 'Cape' American Beach Grass and Fencing*, MARINE EXTENSION BULL. (Woods Hole Sea Grant & Cape Cod Coop. Extension), Dec. 2008 at 1, *available at* http://www.whoi.edu/fileserver.do?id=87224&pt=2&p=88900.

11 *Id.*

12 *Id.*

13 MAUN ANWAR, BIOLOGY OF COASTAL SAND DUNES 11 (2009).

> then wind-blown back into the dune area to naturally rebuild the dunes.[14]

In the words of Rachel Carson, "[o]nce [sediment is] brought to salt water, a fresh rearranging, sorting and transport begin. Light minerals . . . are carried away almost at once; heavy ones . . . are picked up by the violence of storm waves and thrown on the upper beach."[15] Ideally, dynamic equilibrium is a stable cycle that constantly replaces the very sand that it removes.[16] When severe erosion or avulsion (a mass instance of erosion) occurs, the dynamic equilibrium is offset.[17]

The coastal foredune serves as the obstacle that reduces wind velocity to capture sand onshore. The coastal foredune is a large protective sand hill located behind flat beach and the ocean.[18] Plants tolerant of salt spray, strong winds, and sand burial occupy these foredunes.[19] The coastal foredune is a vital, permanent portion of the dune profile, and undergoes dimensional as well as temporal changes of far less magnitude and frequency than the sand beach or the offshore zone.[20] The stability of the foredune structure provides "significant protection for homes, roads, towns and other infrastructure, and serve[s] as a barrier against flooding during major storm surges and perhaps even tsunamis."[21]

B. Massachusetts and Oregon: Economic Stakes in Shoreline Preservation

The states of Massachusetts and Oregon each hold economically valuable coastal property, which is at great risk of significant, naturally occurring coastal erosion. Each state (and their private citizens) implements a variety of erosion mitigation techniques which vary in cost and efficacy. Each technique also has a variety of

---

14 O'Connell, *supra* note 10, at 1.

15 RACHEL CARSON, THE EDGE OF THE SEA 126 (Mariner Books ed., 1998) (1955).

16 O'Connell, *supra* note 10, at 1.

17 *Id.* at 6.

18 Sally Hacker, *Invasion of New Beach Grass Could Weaken Shoreline Protection*, OR. ST. NEWS & RESEARCH COMM. (Sept. 12, 2007), http://oregonstate.edu/ua/ncs/archives/2007/sep/invasion-new-beach-grass-could-weaken-shoreline-protection.

19 A.M. Wiedemann & A.J. Pickart, *4 Temperate Zone Coastal Dunes*, *in* COASTAL DUNES: ECOLOGY AND CONSERVATION 53, 54 (M.L. Martinez et al. eds., 2004).

20 *Id.* at 11–12.

21 Hacker, *supra* note 18.

resulting environmental effects; none of the techniques are permanent solutions.

1. Massachusetts

A 2003 study of shoreline change in Massachusetts by the U.S. Geological Survey, Woods Hole Oceanographic Institution Sea Grant Program (WHOI), and Cape Cod Cooperative Extension revealed that 513 miles of Massachusetts' ocean-facing shore exhibits a long-term erosional trend.[22] Only fifteen miles, or two percent, of the Massachusetts shoreline showed no erosional change.[23] The spokesperson for WHOI conceded, "[f]or the most part, the Massachusetts shore is eroding. For the entire ocean-facing Massachusetts shore, the long-term average annual shoreline change rate ranges between -0.58 and -0.75 feet per year."[24] This advanced rate of erosion and lack of dynamic equilibrium indicated an average of six feet of valuable coastal property loss every ten years.

Such dramatic erosion is nothing new; beginning in the early eighteenth century, colonists began planting beachgrass when they recognized that lack of dune vegetation threatened Provincetown and Provincetown harbor due to erosion.[25] While dune erosion is a historical issue in Massachusetts, recent avulsion events coupled with gradual erosion have brought the issue to the forefront for coastal towns. The destruction in Massachusetts, particularly Nantucket, was documented and emphasized in popular publications such as Yankee Magazine and Vanity Fair.[26] One headline in the Boston Globe read, "Nature's fury wins again on Nantucket," and within that article, the paper reported that a "three-bedroom house was the fifth dwelling in

22 Woods Hole Sea Grant, *New Shoreline Change Data Reveal Massachusetts is Eroding*, WOODS HOLE OCEANOGRAPHIC INST., http://www.whoi.edu/seagrant/page.do?pid=52235&tid=282&cid=88637 (last updated June 24, 2014); *see also* Jim O'Connell, *New Shoreline Change Data Reveal Massachusetts is Eroding*, MARINE EXTENSION BULL. (Woods Hole Oceanographic Inst. Sea Grant Program Cape Cod Coop. Extension), Mar. 2003 at 1, *available at* http://www.whoi.edu/fileserver.do?id=74465&pt=2&p=88637.

23 Woods Hole Sea Grant, *supra* note 22.

24 *Id.*

25 O'Connell, *supra* note 10.

26 Ian Aldrich, *Nantucket Beach Erosion | A Disappearing Island*, YANKEE MAG., Sept./Oct. 2008, at 110, *available at* http://www.yankeemagazine.com/article/features/nantucket-beach-erosion; William D. Cohan & Vanessa Grigoriadis, *From Coast to Toast*, VANITY FAIR, Aug. 2013, at 100, *available at* http://www.vanityfair.com/society/2013/08/end-of-malibu-nantucket-erosion.

the past decade lost to erosion off Madaket, the southwestern end of the island . . . ."[27]

In 2008, *Yankee Magazine* featured an article entitled *Nantucket Beach Erosion–A Disappearing Island*.[28] The article focused on several island residents, predominantly those with coastal property.[29] Eugene Ratnerhad his coastal Nantucket house located in an area where the erosion rate currently averages twelve feet a year.[30] The erosion evidence surrounded his property: homes nearby had been moved or lost to the sea, an abandoned section of road covered by sand, and a concrete sewage tank sat in the middle of the beach.[31] Ratner estimated he sank $500,000 into saving his home from erosion.[32]

In a feature article published in *Vanity Fair* in August of 2013, Nantucket local and resident of the infamously eroding Baxter Road, F. Helmut Wymer said that severe erosion on Baxter Road on Nantucket was "inconceivable" in the 1970s.[33] Wymer recalled, "[the erosion] was fully negated down to the toe of the bluff, and then there was something like 150 feet of dunes and then a wide beach."[34] On that same location, just twelve short years later in 1987, erosion of the bluff was apparent.[35] According to Wymer, "the 150 feet of dunes were largely gone."[36]

The erosion of Baxter Road in Nantucket did not stop at gradual sand removal. In the fall of 1991 and the winter of 1992, two heavy winter storms struck the area.[37] Over sixty feet of beach and some cottages disappeared with the tides and waves; and twenty feet of bluff in front of Sankaty Head Lighthouse fell off.[38] This massive

---

27 Jack Nicas, *Nature's Fury Wins Again on Nantucket*, BOSTON.COM (Dec. 17, 2009), http://www.boston.com/news/local/massachusetts/articles/2009/12/17/natures_fury_wins_again_on_nantucket.

28 Aldrich, *supra* note 26.

29 *Id.*

30 *Id.*

31 *Id*.

32 *Id*.

33 Cohan & Grigoriadis, *supra* note 26, at 100.

34 *Id.*

35 *Id.*

36 *Id.*

37 *Id.*

38 *Id.*

event triggered a drastic move in 2007, the Sankaty Lighthouse moved back 405 feet, at the cost of $4 million.[39]

Original construction of the Sankaty Lighthouse began in 1850 with the base located 250 feet from the bluffs edge.[40] In 1987, the National Register of Historic Places listed Sankaty Lighthouse.[41] In 2007, the distance between the bluff and the lighthouse was seventy-six feet.[42] The lighthouse, still operated by the U.S. Coast Guard, cost more than $4 million to move back to a place where "caretakers hope it will remain safe for another one hundred years."[43] The $4 million spent to temporarily preserve a historical structure is scant compared to the estimated $25 million that beachfront homeowners on Nantucket spent that same year in an effort to add sand to the beaches in front of their houses.[44]

Without an effective erosion control system, the coast of Massachusetts and its islands will continue to disappear, and residents will continue to invest millions of dollars in futile erosion management systems.

2. Oregon

The Oregon coast stretches 360 miles and is composed of wide and gently sloping sandy beaches.[45] Series of foredunes are found in front of almost every sandy beach in Oregon.[46] Despite the gentle slope of most Oregon beaches, the National Oceanic and Atmospheric Agency (NOAA) reported that "[i]ncreased development on borderline sites along the Oregon Coastline puts homes and other stationary structures

---

39 *Id.*

40 EDOUARD STACKPOLE, THE SAGA OF SANKATY 34–42 (1950), *available at* http://www.nha.org/history/hn/HN-1950-sankaty.htm; Sarah Schweitzer, *Traveling Light on Nantucket: Threatened by Erosion, Sankaty Head Lighthouse to Get New Home,* BOSTON.COM (Sept. 30, 2007), http://www.boston.com/news/local/articles/2007/09/30/traveling_light_on_nantucket/.

41 Robert D. Felch, *Sankaty Light: "I See Sankaty, the Mariner's Friend!": The Future of Nantucket's "Blazing Star,"* 56 HISTORIC NANTUCKET 3 (2007), *available at* http://www.nha.org/history/hn/HN-summer07-sankaty.html.

42 *Id.*

43 Schweitzer, *supra* note 40.

44 *Id.*

45 OR. P'SHIP FOR DISASTER RESILIENCE, STATE OF OREGON NATIONAL HAZARDS MITIGATION PLAN at 3-CE-2 (2012), *available at* http://www.oregon.gov/LCD/HAZ/docs/OR_NHMP_2012.pdf.

46 Hacker, *supra* note 18.

at risk."[47] These sloping beaches, increasing economic development along the coastline, and "one of the strongest wave climates in the world," all contribute to erosion that impacts human settlement and economic operation.[48]

Erosion in Oregon is now particularly aggressive, especially due to the chronic inundation of large oceanic waves on the coastline.[49] According to NOAA, "[w]inter wave heights, especially during storms, have been increasing over the past 30 to 50 years."[50] Prior to 1996, researchers estimated the 100-year storm wave to be about ten meters, or thirty-three feet in height.[51] However, since 1997, the Oregon coast experienced the equivalent of nine 100-year events.[52] Revised estimates of the 100-year storm now place it at around fifteen to sixteen meters, or about fifty feet.[53] The erosional effects from increasing wave heights are greater than the impact of sea-level rise currently affecting this coastline, although the two are related.[54] If increasing wave heights resulting from climate change were mutually exclusive from rising sea levels, the waves would pose a greater threat to coastal erosion.[55] However, while sea-level rise as a result of climate change is a significant factor in the changing coastal landscape, the most imminent threat is the increasing intensity of storm surges and waves.[56] For example, in 2010, the town of Neskowin, Oregon already experienced "problems with high water

---

47 *The Wave of the Future*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., http://www.noaa.gov/features/03_protecting/oregonwaves.html (last visited Oct. 5, 2014).

48 Or. State Univ., *OSU to Oregon Coast: 'Plan for Heavier Wave Impacts and Erosion'*, KVAL.COM (published Jan. 25, 2010, 3:10 PM PDT; last updated Jan. 25, 2010, 3:53 PM PDT), http://www.kval.com/news/local/82631097.html (quoting Peter Ruggiero, assistant professor in the Oregon State University Department of Geosciences).

49 *Id.*

50 *The Wave of the Future*, *supra* note 47.

51 Or. Dep't of Geology & Mineral Res. & Nw. Ass'n of Networked Ocean Observing Sys., *Oregon Beach and Shoreline Mapping and Analysis Program: Pacific Northwest Estuaries and Shores*, OREGONGEOLOGY.ORG, http://www.oregongeology.org/sub/Nanoos1/objectives.htm (discussing the established tendency of cyclical 100-year events) (last visited Oct. 5, 2014).

52 *Id.*

53 *Id.*

54 *The Wave of the Future*, *supra* note 47.

55 *Id.*; *see* Or. State Univ., *supra* note 48.

56 *See The Wave of the Future*, *supra* note 47; *see also* Or. State Univ., *supra* note 48.

levels and coastal erosion," including "[s]ome commercial structures there occasionally [losing] the use of their lower levels."[57]

Peter Ruggiero, assistant professor at the Oregon State University Department of Geosciences explained:

> Possible causes [of increased wave height] might be changes in storm tracks, higher winds, more intense winter storms, or other factors. . . . [They] probably are related to global warming, but could also be involved with periodic climate fluctuations such as the Pacific Decadal Oscillation, and our wave records are sufficiently short that we can't be certain yet. But what is clear is the waves are getting larger.[58]

Coastal dune erosion is a significant threat to the economic viability of coastal areas of the United States. The states of Massachusetts and Oregon are both experiencing high levels of erosion that endangers homes, businesses, and valuable historical structures. Without proper dune erosion control mechanisms, these assets along with millions of dollars will continue to disappear.

C. Erosion Mitigation: Techniques and Efficacy

When valuable coastal structures and vistas are at stake, homeowners and government bodies will spare no expense to stave off erosion. There are three dominant techniques to manage coastal erosion: hard erosion controls, soft erosion controls, and relocation.[59]

Hard erosion controls are permanent infrastructure in or near the water to alter movement of water and sediment.[60] A common example of a hard erosion control is a seawall. While seawalls last longer than more temporary erosion controls, such as sandbags, the hard erosion controls can actually increase erosion at the base and ends of the structure, leading to a steeper beach profile that perpetuates the erosional effect of waves.[61] In addition, seawalls prevent the

---

57 Or. State Univ., *supra* note 48 (quoting Peter Ruggiero, assistant professor at the Oregon State University Department of Geosciences).

58 *Id.*

59 Jennie Dean, Oceanfront Sandbag Use in North Carolina: Management Review and Suggestions for Improvement (May 2009) (unpublished Masters of Environmental Management Project, Nicholas School of the Environment of Duke University), *available at* http://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/957/OceanfrontSandbags-JDean.pdf?sequence=1.

60 *Id.* at 7.

61 *Id.* at 7.

continuation of dynamic equilibrium by stopping loose sand from being blown back onto the foredune.[62]

The beaches of Oregon were first protected for public use in 1915, with more permanent protection in 1967 with the passage of the Oregon Beach Bill.[63] The Oregon Beach Bill decreed that all land within sixteen vertical feet of the average low tide mark belongs to the people of Oregon and guarantees that the public has free and uninterrupted use of the beaches along Oregon's 360 miles of coastline.[64] Construction of seawalls as erosion control would impede this public access and therefore is not a possible solution for Oregonian coastal dune erosion.

Soft erosion controls are used to temporarily slow the effects of erosion.[65] A common soft erosion control technique is "beach nourishment."[66] Beach nourishment is dumping imported sand onto eroding beaches.[67] This technique is "an inherently sacrificial process" since the added sand does not eliminate the underlying erosion, just postpones it until the new sand is also gone.[68] There was a movement to bring public beach nourishment to Nantucket, but fishermen protested, arguing that more sand on the beaches "threatened their livelihood" by covering fish feeding and breeding grounds with sediment.[69] In 2007, however, Nantucket beachfront homeowners spent $25 million on beach nourishment to postpone the inevitable lapping of the ocean on their very expensive front doors.[70]

Planting and promoting the growth of foredune vegetation falls within the soft erosion control strategy because it does not involve the construction of a semi-permanent structure, nor does it involve avoiding the natural erosion process altogether. However, planting beachgrass does not always pan out: "Over a 30–40 year period it has been observed that . . . American Beachgrass is susceptible to decline

---

62 *Id.* at 7.

63 Oregon Coast Visitors Ass'n, *Facts & FAQ*, OREGON THE PEOPLE'S COAST, http://visittheoregoncoast.com/faq/ (last visited Nov. 23, 2013).

64 *Id.*

65 Dean, *supra* note 59, at 10.

66 *Id.* at 13.

67 Cohan & Grigoriadis, *supra* note 26, at 103.

68 Dean, *supra* note 59, at 13.

69 Cohan & Grigoriadis, *supra* note 26, at 103.

70 Schweitzer, *supra* note 40.

after six to eight years when artificially established."[71] Still, the state of Massachusetts includes American beachgrass (*Ammophila breviligulata*) on the list of recommended plants for Massachusetts' coastline stabilization.[72]

The third major erosion management strategy is relocation, or "managed retreat."[73] This form of erosion management is less of a control mechanism and more of human adaptation. An example of this is structure relocation, where a building, such as the Sankaty Lighthouse on Nantucket, was relocated to a new position, farther from the ocean.[74]

While there are multitudes of ways to postpone erosion, once dynamic equilibrium is upset, it is exceedingly difficult for humans to cope with the effects. The construction of seawalls, beach nourishment, and relocation are all costly, time-consuming, and in the end, unable to stop the erosion process. With so much economic value of the United States located on the coast, there is no doubt that these tactics will continue to be employed as erosion continues to eat away at our nation's coastlines. Common erosion control mechanisms, such as planting dune-stabilizing plants, could (and do) open the door for an inundation of invasive species. Clear and explicit regulations are the only way to prevent this unnecessary barrage of invasive species.

II
WHAT MAKES A SPECIES INVASIVE?

Invasive species is a term that several authoritative bodies attempt to define. In order to be effective, the definition must include specific temporal criteria and spatial criteria and must not have a caveat where economic incentives can preempt the legislations intent. The following sections will discuss the purposes and technicalities in vocabulary used in the primary federal, Massachusetts, and Oregon definitions of *invasive species*, as well as the efficacy in fulfilling their objectives.

---

71 O'Connell, *supra* note 10, at 11 (citation omitted).

72 Mass. Exec. Office of Energy and Envtl. Affairs, *Coastal Landscaping Plant List*, MASS.GOV, http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/coastal-landscaping/plants.html#native (noting American beachgrass is promoted in Massachusetts, not European beachgrass) (last visited Sept. 13, 2013).

73 Cohan & Grigoriadis, *supra* note 26, at 103.

74 Schweitzer, *supra* note 40.

A. Federal Authority: Definition and Objective

The federal definition of *invasive species* is not consistent among federal statutes. According to the United States Department of Agriculture (USDA) and the most recent presidential Executive Order, *invasive* is interchangeable with *non-native*, *alien*, *non-indigenous*, and *exotic*.[75]

The first governmental attempt at defining *invasive species* came in 1977 in an executive order entitled "Exotic Organisms."[76] President Jimmy Carter promulgated the order to curb detrimental species introduction in furtherance of the purposes and policies of the National Environmental Policy Act of 1969 (NEPA).[77] NEPA seeks to "recogniz[e] the profound impact of man's activity on the interrelations of all components of the natural environment,"[78] and "attain the widest range of beneficial uses of the environment *without degradation, risk to health or safety, or other undesirable and unintended consequences.*"[79]

The subsequent executive order defined *invasive species* as: "all species of plants and animals not naturally occurring, either presently or historically, in any ecosystem of the United States."[80] While there was clear effort to define *invasive*, the order's definition lacked an explanation of "naturally occurring," "historically," or "presently," therefore bypassing the clear need of a temporal scale to make the order effective. Without a temporal scale, there was no way to determine when a species was deemed invasive, since a species' habitat and geographic location are constantly in flux.[81]

The enactment of a 1999 Executive Order entitled "Invasive Species" superseded the 1977 "Exotic Organisms" order, but

---

75 Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999); U.S. Dep't of Agric., *What is an Invasive Species?*, NAT'L INVASIVE SPECIES INFO. CENTER, http://www.invasivespeciesinfo.gov/laws/execorder.shtml (last modified Oct. 29, 2014).

76 Exec. Order No. 11987, Exotic Organisms, 42 Fed. Reg. 26,949 (May 24, 1977).

77 *Id.*; National Environmental Policy Act of 1969, Pub. L. No. 91-190, 83 Stat. 852 (codified as amended at 42 U.S.C. § 4331 (2012)).

78 National Environmental Policy Act § 4331(a).

79 § 4331(b) (emphasis added).

80 Exotic Organisms, 42 Fed. Reg. at 26,949.

81 Pa. State Univ., *Ecological Succession*, THE VIRTUAL NATURE TRAIL AT PENN STATE NEW KINSINGTON, http://www.psu.edu/dept/nkbiology/naturetrail/succession.htm (last updated July 12, 2009).

maintained the previous *invasive species* definition.[82] The controlling federal definition of *invasive species* remained vague and lacked a temporal scale.[83] The purpose of the "Invasive Species" order was very similar to the preceding one, but sought "to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause."[84] This new Executive Order also served to pinpoint the meaning of *invasive species*. The lack of a clear definition of *invasive* in this federal context does not allow regulations to curb the potential degradation of the natural environment caused by invasive species. Included in this slew of environmental regulations is the Aquatic Nuisance Prevention and Control Act of 1990 (ANPCA).

The purpose of ANPCA is to curb the unintentional introduction and dispersal of non-indigenous species into aquatic environments in the United States.[85] For the purpose of ANPCA Congress found "when environmental conditions are favorable, nonindigenous species become established, may compete with or prey upon native species of plants, fish, and wildlife, [and] may carry diseases or parasites that affect native species."[86]

ANPCA defined an *aquatic nuisance species* as a "nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural, or recreational activities dependent on such waters."[87] The act also defined *unintentional introduction* as "an introduction of nonindigenous species that occurs as the result of activities other than the purposeful or intentional introduction of the species involved."[88] Despite this attempt to clarify intent with several circular definitions, there was no clear definition of *nonindigenous species*. ANPCA defined *nonindigenous* as one which "enters an ecosystem beyond its historic range, including any such organism transferred from one country to another."[89] Again, while there was clear effort to define the

---

82 Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999); U.S. Dep't of Agric., *supra* note 75.

83 *Id*.

84 Invasive Species, 64 Fed. Reg. at 6183.

85 Aquatic Nuisance Prevention and Control Act, 16 U.S.C. § 4701 (2012).

86 *Id.* § 4701(a)(2).

87 *Id.* § 4702(1).

88 *Id.* § 4702(17).

89 *Id.* § 4702(11).

detrimental biological threat that the ANPCA sought to prevent, the definitions lacked clarity and a temporal scale to make the order effective. Without this vital temporal reference, there was no way to tell if ANPCA's definition referred to invasive species as one new to an area within one hundred years or within one thousand. ANPCA's purpose statement clearly speaks to the purposes of enacting invasive species legislation: to stop ecological harm to native species and habitats resulting from the introduction and presence of invasive species.[90] However, by providing such a vague and circular definition of *invasive species*, neither Executive Order 13112 nor ANPCA enacted definitions consistent with their purposes.[91]

The USDA provided more circular, confusing definitions. The USDA borrowed the definition of *invasive species* from Executive Order 13112, which defined *invasive* as: "a species that is: 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm to human health."[92] Further, the USDA also defined *alien species*: "[w]ith respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem."[93] In order to understand the definition of *alien* and *invasive*—because the definitions are based on an understanding of the antonymic concept of *native*—one must look at the definition of the word. *Native species* are defined as, "with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem."[94] None of the definitions of invasive included in Executive Order 13112, ANPCA, or used by the USDA include a time frame to base a determination of invasive.

The USDA website contains numerous links to state, federal, and international economic impacts from invasive species.[95] Links on the government website include: "Research Show Invasive Species Cost

---

90 *Id.* § 4701.

91 Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999); Aquatic Nuisance Prevention and Control Act, 16 U.S.C. § 4702 (2012).

92 U.S. Dep't of Agric., *supra* note 75; Invasive Species, 64 Fed. Reg. at 6183.

93 Invasive Species, 64 Fed. Reg. at 6183.

94 *Id.*

95 U.S. Dep't of Agric., *Economic Impacts*, NAT'L INVASIVE SPECIES INFO. CENTER, http://www.invasivespeciesinfo.gov/economic/main.shtml (last modified July 1, 2014).

the Great Lakes Millions: New Paper Assigns Dollar Figure to Effects of Shipborne Invaders"; and "Study Finds that Local Government, Home Owners Are Paying For Damages Caused by Non-native Forest Insects".[96] The USDA states on its website that we must work to prevent the inundation and spread of invasive plants because "[i]nvasive plants spread into areas choking out or displacing the native vegetation" and may "cause environmental harm or harm to humans."[97] However, despite this overarching ecologically purist purpose included in all aforementioned federal regulations, the definitions of *invasive* provided do not meet the purposes of those acts and are therefore ineffective.

The promulgation of Executive Order 13112 established the National Invasive Species Council (NISC), which is an inter-departmental body that "helps to coordinate and ensure complementary, cost-effective Federal activities regarding invasive species."[98] In April of 2006, the NISC issued an "Invasive Species Definition Clarification."[99] The clarification included the following provision: "For a non-native organism to be considered an *invasive species* in the policy context, the negative effects that the organism causes or is likely to cause are deemed to outweigh any beneficial effects."[100] The council went on to state that "[m]any non-native introductions provide benefits to society and even among species that technically meet the definition of invasive, societal benefits may greatly exceed any negative effects."[101] The NISC listed farm animals to defend this assertion.[102]

In sum, every federal attempt at a definition of *invasive species* is vague and lacks a temporal scale to base the definition on. The collective purposes of these federal laws are not met by such a vague

---

96 *Id.*

97 *Forest Heath Protection—Invasive Plants*, U.S. FOREST SERVICE, http://na.fs.fed.us/fhp/invasive_plants/faq/index.shtm (last modified July 5, 2011).

98 U.S. Dep't of Agric., *About NISIC Federal Government's Response*, NAT'L INVASIVE SPECIES INFO. CENTER, http://www.invasivespeciesinfo.gov/response.shtml (last modified July 18, 2012); Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999).

99 DEFINITIONS SUBCOMM. OF THE INVASIVE SPECIES ADVISORY COMM., INVASIVE SPECIES DEFINITION CLARIFICATION AND GUIDANCE WHITE PAPER (2006), *available at* http://www.invasivespecies.gov/global/ISAC/ISAC_documents/ISAC%20Definititions%20White%20Paper%20%20-%20FINAL%20 VERSION.pdf.

100 *Id.* at 3.

101 *Id.*

102 *Id.*

and malleable definition of *invasive species.* All federal interpretations of *invasive* heavily depend upon the negative effects those species have on the economy. For instance, if a species from another continent is beneficial to the economy, it is not invasive despite where its origins may lie. In addition, there is no temporal span included in the federal definition to determine when a species is invasive. Without a time scale to base the definition on, nearly every biota on earth is invasive—consider that 25,000 years ago, the Laurentide Ice Sheet covered New England which prevented plants and animals from living in that area.[103] Thus, according to the federal definition of *invasive* and the use of the ambiguous phrase "historic range," any living thing that currently resides in that previously icy region is invasive simply because it has not always been there. Conversely, the historic range could include this century, making the majority of existing species non-invasive. Either interpretation of the regulation does not help the federal objective of eradicating or preventing import of those species that cause harm to the environment.[104] For a federal statute to prevent and curb the inundation of harmful species effectively, it must precisely define a time scale of how long that species must proliferate in a location before it is no longer considered invasive.

B. Massachusetts: Definition and Objective

The purpose of defining *invasive species* for the state of Massachusetts aligns with overarching federal goals: prevent and eradicate plants that cause economic or environmental harm.[105] The Executive Office of Energy and Environmental Affairs in Massachusetts ("Massachusetts") adopted this definition:

> For a species to be designated as "invasive", "likely invasive" or "potentially invasive" it must meet base criteria (#1-4 below). The species must: 1. Be nonindigenous to Massachusetts. 2. Have the biologic potential for rapid and widespread dispersion and establishment in minimally managed habitats. 3. Have the biologic

---

103 ROBERT N. OLDALE, U.S. GEOLOGICAL SURVEY, GEOLOGIC HISTORY OF CAPE COD, MASSACHUSETTS, GLACIAL CAPE COD., http://pubs.usgs.gov/gip/capecod/glacial.html (last visited Oct. 15, 2014).

104 U.S. Dep't of Agric., *supra* note 75.

105 MASS. INVASIVE PLANT ADVISORY GRP., THE EVALUATION OF NON-NATIVE PLANT SPECIES FOR INVASIVENESS IN MASSACHUSETTS (2005), *available at* http://www.mass.gov/eea/docs/dfg/nhesp/land-protection-and-management/invasive-plant-list.pdf.

> potential for dispersing over spatial gaps away from site of introduction. 4. Have the biologic potential for existing in high numbers away from intensively managed artificial habitats.[106]

Massachusetts also goes on to define *non-native plant species* as "a plant that is non-indigenous and not naturally occurring to the region."[107] While these expansions to the definition of *invasive* may seem as circular as the federal definition at first glance, Massachusetts further developed the definition of *invasive* by clarifying the interpretation of its antonym, *indigenous*. The definition reads, "[i]ndigenous species often have a pre-colonial presence (pre 1500) or have arrived in the region more recently without the aid of human intervention."[108] Thus, the Massachusetts definition of *invasive* includes a temporal scale: the species must have arrived in a locale after the year 1500 A.D.

However, similar to the "Invasive Species Definition Clarification" issued by the NISC, Massachusetts conceded that "not all non-native plants are invasive. Non-native plants that are not considered invasive are those that generally do not rapidly disperse, become established, or create self-sustaining or dominant populations that would be disruptive to the natural ecosystem."[109] It is important to note that both the Massachusetts and federal definitions of invasive include caveats for species that may initially fall under the definition, but are not deemed harmful. Massachusetts exempts those species that do not present a harmful impact to the local ecology or do not have a tendency to reproduce and become dominant. This contrasts with the federal exception, where an exemption is given to a species if "societal benefits may greatly exceed any negative effects."[110]

While the purpose of defining *invasive species* is congruent to the objective behind federal invasive species regulation, the state of Massachusetts employed more clear criteria with a grading system to determine the true threat of a species. Both Massachusetts and federal legislation seek to prohibit invasive species from decimating the local ecology; however, only the Massachusetts definition is clear enough to lend itself to uniform application.

---

106 *Id.* at 5 (typeface altered from original).

107 Mass. Exec. Office of Energy and Envtl. Affairs, *supra* note 72.

108 MASS. INVASIVE PLANT ADVISORY GRP., *supra* note 105, at 7.

109 Mass. Exec. Office of Energy and Envtl. Affairs, *supra* note 72.

110 DEFINITIONS SUBCOMM. OF THE INVASIVE SPECIES ADVISORY COMM., *supra* note 99, at 3.

C. Oregon: Definition and Objective

The state of Oregon relies heavily on the definition of *invasive species* from federal authority and defines the term as "a non-native species whose introduction does, or is likely to, cause economic or environmental harm or harm to human health."[111] An *invasive species* can be a plant, animal, or any other biologically viable species that enters an ecosystem beyond its native range.[112] In contrast to the federal definition, the Oregon definition of *native species* refers to those plant or animal species originally living, growing, or produced in an ecosystem within their historic range.[113] Although Oregon added the phrase "historic range," the State did nothing to define that space or the time periods over which a species may inhabit those areas—much like the federal definition.

The purpose of Oregon's *invasive* definition is to advance the goals enumerated in Executive Order 13112, which include prevention of ecological harm to local areas.[114] However, Oregon's vague definition lends itself to subjective interpretation and therefore inconsistent enforcement of ecologically based regulations.

D. Scientifically Speaking: The Gap Between Science and Law

The purposes behind Executive Order 13112 and other controlling federal regulations on invasive species are ecologically based.[115] However, there is a clear lack of continuity between prevailing scientific definitions and those included in the legislation. Ecological problems, such as the influx of invasive species, cannot be fixed without applying the proper scientific understanding of what *invasive* really means. Considering this, there is a significant lack of consistency between legislative definitions and scientific understandings of biological communities.

The International Union for Conservation of Nature (IUCN) defined *invasive species* as "animals, plants or other organisms

---

111 Or. Invasive Species Council, *Frequently Asked Questions*, OREGON.GOV, www.oregon.egov.com/oisc/Pages/faqs.aspx (last visited Oct. 16, 2013); *see* Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999).

112 Or. Invasive Species Council, *supra* note 111.

113 *Id.*

114 Invasive Species, 64 Fed. Reg. at 6183.

115 *Id.*; Aquatic Nuisance Prevention and Control Act, 16 U.S.C. § 4701 (2012); U.S. Dep't of Agric., *supra* note 75.

introduced by man into places out of their natural range of distribution, where they become established and disperse, *generating a negative impact on the local ecosystem and species.*"[116] While this definition lacks a temporal scale, it includes a spatial scale in terms of a species distributing itself, and also contains the provision of negative impact on local ecosystem and species.

NOAA classified a *nonindigenous species* as an organism found living beyond its historic native range, which is usually taken as the area where it evolved to its present form.[117] Like the Massachusetts definition of *invasive species*, this definition of *nonindigenous* quantifies a time period. To clarify, "[a]n invasive species is also, by definition, *nonindigenous*."[118] While NOAA supplied this scientifically applicable definition, it has not yet been incorporated into any primary federal authority. For states to effectively enforce federal legislation pertaining to invasive species, they must have a clear scientific primary authority to apply. Since the NOAA definition was not incorporated into any federal legislation, states are not obligated to interpret and apply it to their own regulation enforcement.

The federal, Massachusetts, and Oregon definitions of *invasive species* all include a provision regarding the tendency to displace local flora and fauna and cause ecological harm, but only Massachusetts' definition includes a temporal scale. Without a definitive temporal or spatial scale, there is no basis for evaluating whether a species is invasive in an area or not. The federal and Oregon definitions of invasive were written deficiently and focus on the economic effect a species may have on human environments despite the enumerated purpose "to prevent the introduction of invasive species and provide for their control and to minimize the economic, *ecological*, and human health impacts that invasive species cause."[119] This is in sharp contrast with the more ecological

---

116 Sarah Zielinski, *Are Humans an Invasive Species?*, SMITHSONIAN.COM (Jan. 31, 2011) (emphasis added), http://www.smithsonianmag.com/science-nature/are-humans-an-invasive-species-42999965/.

117 NAT'L OCEANIC AND ATMOSPHERIC ADMIN., EXOTIC, INVASIVE, ALIEN, NONINDIGENOUS, OR NUISANCE SPECIES: NO MATTER WHAT YOU CALL THEM, THEY'RE A GROWING PROBLEM (2002), *available at* http://www.glerl.noaa.gov/pubs/brochures/invasive/ansprimer.pdf (last visited Oct. 15, 2014).

118 *Id.*

119 Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999) (emphasis added).

interpretation of the words that include a detrimental effect on native species, such as the language included in the Massachusetts definition.

These distinctions in the definitions of *invasive* produce varying results when it comes to classifying a species. Although the goals of federal, Massachusetts, and Oregon invasive species legislation align in preventing ecological degradation of land, the implementation of such regulations vary drastically based on the definition of *invasive species* being vague. This is easily illustrated by European beachgrass and coastal dune stabilization.

III
EUROPEAN BEACHGRASS—INVASIVE?

As illustrated by its name, European beachgrass is not from the United States.[120] This patent reference to its ancestral roots, together with its bicoastal potential habitat and adaptability, make European beachgrass an ideal species to illustrate the disparities between the Massachusetts and Oregon *invasive species* definitions. To fully analyze the aforementioned state definitions, the biology and reproductive habits of European beachgrass must be discussed. The federal definition of *invasive* is not necessary to analyze because of the analogous wording in the Oregon regulation.

A. Plant Biology of European Beachgrass (Ammophilia arenaria)

Ammophilia arenaria, or more commonly, European beachgrass, is a perennial grass that originally evolved to its present state in Europe between the latitudes of 30 and 63 degrees north.[121] It is a rhizomatous plant, which means it spreads and reproduces underground with root-like structures.[122] Rhizomes are not the only means of European beachgrass reproduction as it also produces viable seeds.[123] Active sand burial stimulates and promotes rhizome growth

120 *See generally* ANDREA J. PICKART, CONTROL OF EUROPEAN BEACHGRASS (AMMOPHILIA ARENARIA) ON THE WEST COAST OF THE UNITED STATES (1997), *available at* http://www.cal-ipc.org/symposia/archive/pdf/1997_symposium_proceedings1934.pdf.

121 *Id.*

122 *Id.*

123 *Id.*

such that dense clusters of shoots result.[124] As previously described, there are three essential requirements for the establishment and continuation of dynamic equilibrium: a prevailing onshore wind, a continuous supply of sand, and an obstacle to reduce the velocity of the wind to capture the land being blown onshore.[125] European beachgrass—with its aggressive reproduction and high tolerance of stressful conditions—is very effective at establishing communities on foredunes and accelerating accretion.[126]

B. Massachusetts Classification

Taking into consideration the state's elaboration on specific terms within the definition, European beachgrass is detrimentally invasive in Massachusetts.[127] The purpose of the state's strict and carefully outlined definition of *invasive* is to prevent ecological harm, and Massachusetts' four-step definition allows room for interpretation and analysis of species while objectively determining whether something is invasive.

European beachgrass is nonindigenous to Massachusetts because the State holds that "[i]ndigenous species often have a pre-colonial presence (pre 1500) or have arrived in the region more recently without the aid of human intervention."[128] European beachgrass does not yet have a presence in Massachusetts, and therefore does not have a precolonial presence.[129] If the plant does arrive, it will most likely be traceable to human intervention. The species is also fast growing, reproduces independently, and can withstand extreme sandy and salty conditions.[130] In addition, long distance dispersal occurs by marine

---

124 *Id.*

125 ANWAR, *supra* note 13, at 11.

126 *Id.* at 14; *see also supra* Part I.A.

127 *See* MASS. INVASIVE PLANT ADVISORY GRP., *supra* note 105 (Defining *invasive species* as species: 1. nonindigenous to Massachusetts. 2. with biologic potential for rapid and widespread dispersion and establishment in minimally managed habitats. 3. with biologic potential for dispersing over spatial gaps away from the site of introduction. 4. with biologic potential for existing in high numbers away from intensely managed artificial habitats.).

128 *Id.* at 7.

129 Natural Resources Conservation Serv., Ammophila arenaria *(L.) Link European Beachgrass*, USDA.GOV, http://plants.usda.gov/core/profile?symbol=AMAR4 (last visited Oct. 15, 2014).

130 *European Beach Grass*, OR. COAST AQUARIUM, http://aquarium.org/exhibits/sandy-shores/animals/european-beach-grass (last visited Oct. 15, 2014); Pickart, *supra* note 120, at 1.

transport of dormant rhizomes.[131] The aforementioned tendencies fulfill the second, third, and fourth elements of the Massachusetts definition of *invasive*. But Massachusetts conceded "not all non-native plants are invasive. Non-native plants that are not considered invasive are those that generally do not rapidly disperse, become established, or create self-sustaining or dominant populations that would be disruptive to the natural ecosystem."[132] European beachgrass, with its proficient reproduction capability, has the potential to threaten local species with crowding, making it both an invasive species and an enumerated danger to Massachusetts coastal ecosystems.[133] This definition and four-step process leads to an accurate and enforceable classification that serves the objectives of Massachusetts invasive species policies.

C. Oregon Classification

Oregon's definition of *invasive species* is heavily based upon the federal definition, and like its federal predecessor, the Oregon definition is vague and does not help further the purpose behind invasive species legislation.[134] In Oregon, an *invasive species* is "a non-native species whose introduction does, or is likely to, cause economic or environmental harm or harm to human health."[135] "An *invasive species* can be a plant, animal, or any other biologically viable species that enters an ecosystem beyond its native range."[136] In contrast, the Oregon definition of *native species* "refers to those plant or animal species originally living, growing, or produced in an ecosystem within their historic range."[137] Although Oregon adds phrases such as "historic range" and "native range," the State does nothing to define those spaces or the time periods over which a species may inhabit those areas. Thus, it is impossible to determine accurately if a species produces a negative impact on an ecosystem because there is constant competition between species and plant

131 PICKART, *supra* note 120, at 1.

132 Mass. Exec. Office of Energy and Envtl. Affairs, *supra* note 72.

133 *Id.*; DEFINITIONS SUBCOMM. OF THE INVASIVE SPECIES ADVISORY COMM., *supra* note 99.

134 *See* Or. Invasive Species Council, *supra* note 111; *see also supra* Part II.C.

135 Or. Invasive Species Council, *supra* note 111.

136 Or. Invasive Species Council, *supra* note 111; *see also supra* Part II.C.

137 *Id.*

succession in a habitat composed of all "native" species.[138] Due to the vagueness of the spatial and temporal parameters of Oregon's definition of *invasive species*, it is important to look at another key provision: potential economic harm.

European beachgrass was first introduced on the West Coast of the United States at Golden Gate Park, San Francisco in the late 1800s.[139] "[T]he species was heralded as a desirable sand stabilizer and was eventually embraced by the U.S. Soil Conservation Service and other agencies."[140] In the 1920s, "concern that natural erosion was destroying valuable coastal real estate prompted the federal and Oregon state governments to encourage citizens to plant European Beach Grass [to] stabilize the beaches and dunes."[141] The grass was extensively planted along the Oregon Coast in the 1930s and again in the 1950s and early 1960s—mostly along the inner edge of the active dune margin—to prevent sand from blowing into rivers and onto railroads and highways.[142] "European beach grass did so well that by the 1930s it had spread along the entire Oregon coast, and created an extensive 'foredune' system."[143] These dunes can provide "significant protection for homes, roads, towns and other infrastructure, and serve as a barrier against flooding during major storm surges and perhaps even tsunamis."[144] European beachgrass has been dominant along the Oregon coast since the 1930s.[145]

Economically speaking, European beachgrass in Oregon "did its job extremely well," says Sally Hacker, an Oregon State University (OSU) associate professor of zoology and expert on marine and estuarine communities.[146] "Without it," Hacker continues, "the sand would cover towns and roads."[147] However, while the foredune system created by European beachgrass is good for coastal landowners, "it is not so good for endangered beach plant species and the federally-threatened Western snowy plover . . . As more sand

---

138 *See* Pa. State Univ., *supra* note 81.

139 PICKART, *supra* note 120, at 1.

140 *Id.*

141 OR. COAST AQUARIUM, *supra* note 131.

142 Alfred M. Wiedmann, *Coastal Foredune Development, Oregon, USA*, 26 J. COASTAL RES. 45, 45–51 (1998).

143 Hacker, *supra* note 18.

144 *Id.*

145 *Id.*

146 *Id.*

147 *Id.*

accumulates in growing stands of beachgrass, the land behind the dune tends to get 'terrestrialized,' or turned into wetlands and forest habitats."[148]

While there are clear detrimental ecological effects of the presence of European beachgrass, the Oregon definition of *invasive species* is not clear enough to provide a scientific basis for determining if a species is invasive or not because it lacks spatial and temporal parameters. It is not merely enough to show detrimental effects on a habitat. The economic harm element led to an impact analysis that indicated European beachgrass was not harmful to human enterprises on Oregon shorelines—in fact, they were incredibly beneficial by preventing damage from storm surges and providing foredune stabilization.[149] Therefore, European beachgrass is not invasive in Oregon—it is merely exotic.

IV
COMPARATIVE ANALYSIS: CREATING AN EFFECTIVE DEFINITION

For a definition of *invasive species* to be effective at advancing the purposes of federal and state legislation, the definition must be universally applicable and scientifically based. Further, it must also include both spatial and temporal reference points.

The federal definition of *invasive species* provides an overarching definition so states can adhere to regulations, such as Executive Order 13112.[150] At first glance, it may seem like *invasive species* should be a flexible phrase, malleable to fit a variety of purposes. Without flexibility of the phrase, how can legislation seek to promote economic welfare while simultaneously balancing environmental interests? There is a way to inject flexibility into the definition without detracting from its universal enforceability.

The purpose of Executive Order 13112 is "to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause."[151] The federal government has a long-

148 *Id.*

149 *Id.*

150 Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999).

151 Invasive Species, 64 Fed. Reg. at 6183; U.S. Dep't of Agric., *Federal Laws and Regulations Executive Order 13112*, NAT'L INVASIVE SPECIES INFO. CENTER, www.invasivespeciesinfo.gov/laws/execorder.shtml (last modified Oct. 29, 2014).

standing reputation for enacting conservation legislation then dragging its feet in making that legislation enforceable and effective.[152] Congress and federal agencies traditionally take time after the enactment of groundbreaking legislation to modify and pinpoint the true conservational purposes of those rules. For example, Congress enacted the Taylor Grazing Act in 1934 to regulate grazing in the American west.[153] In the original act, however, guidelines to curb environmental degradation did not exist; Congress simply did not lay out any mechanisms for regulation. Similarly, federal invasive species regulation is relatively young. Executive Order 13112 lays out the idea that invasive species can be harmful to both humans and the environment. Nevertheless, there is ample room for loopholes and subjective interpretation, because the Executive Order does not precisely state what qualifies as an *invasive species*, nor does it outline mechanisms for control.

The lands and coasts of the United States are not static; they shift and change with human activities and natural phenomena.[154] Due to this constant flux in species and habitats, it is vital to include spatial and temporal reference points to make enforcement and eradication of selected species (i.e., invasive) effective. The federal definitions of *invasive species* as enumerated by Executive Order 13112, ANPCA, and that used by the USDA contain neither of those elements.[155] Executive Order 13112 defines *invasive species* as "all species of plants and animals not naturally occurring, either presently or historically, in any ecosystem of the United States."[156] While this definition illustrates an effort to define *invasive*—attempting to introduce a temporal scale—the order's definition lacks explanation of its key temporal reference points: "naturally occurring" and "historically."[157] The use of the ambiguous phrase "historically," means that any living plant or animal that currently resides in that region is invasive in historical relation to that event. "Historic" could

---

152 Debra L. Donahue, *Western Grazing: The Capture of Grass, Ground, and Government*, 53 ENVTL. L. 721, 729 (2005) (discussing the conflicting history of conservation-based federal ordinances and their agency-driven economic rationale).

153 Taylor Grazing Act, 43 U.S.C. § 315 (2014).

154 *Land Change Science Program*, U.S. GEOLOGICAL SURV., http://www.usgs.gov/climate_landuse/lcs/default.asp (last modified May 9, 2013).

155 Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999); U.S. Dep't of Agric., *supra* note 75; Aquatic Nuisance Prevention and Control Act, 16 U.S.C. § 4701 (2012).

156 Exec. Order No. 11897, Exotic Organisms, 42 Fed. Reg. 26,949 (May 24, 1977).

157 *Id.*

be the last ice age or it could be this century, which makes the majority of existing species non-invasive. This ambiguity of the regulation does not help the federal objectives of the legislation prohibit and remove species that do not belong and cause harm to the environment.[158]

For a federal statute to effectively further its own purpose and prevent and curb the inundation of harmful species, it must precisely define a time scale of how long that species must proliferate in a location before it is no longer considered invasive. Therefore, without clarifying what is meant by "historically," the primary federal invasive definition bypasses the clear need of a temporal scale and renders itself ineffective. Without a temporal scale, there is no way to determine when a species is deemed invasive or not, since there is also constant competition between species and plant succession in a habitat composed of all "native" species.[159]

Another caveat of the federal definition is that invasive heavily depends upon the negative effects those species have on the economy: If a species from another continent is beneficial to the economy, it is not invasive despite where its origins may lie. For example, NOAA stated that the *alewife*, a nonindigenous fish that was first reported in the Great Lakes in 1873, was considered a costly nuisance species in the mid-twentieth century.[160] Due to its distant place of origin (making it nonindigenous) and negative impacts, the *alewife* would have been an invasive species during the mid-twentieth century by the current federal standards. However, today the *alewife* is considered a valuable food source for salmon and lake trout that support a multibillion dollar sport fishery.[161] With the current federal definition, the *alewife* is no longer invasive simply because it provides an economic benefit, despite the location of the *alewife's* origin and its inevitable impact on the local biodiversity of its new habitat.

The primary federal definition of *invasive* is inadequate and ineffective in aiming to meet the goals of federal legislation such as

158 U.S. Dep't of Agric., *supra* note 75.

159 *See* Pa. State Univ., *supra* note 81.

160 NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 117.

161 *See id.*

NEPA, ANPCA, and Executive Order 13112.[162] Unless the federal definition is altered to specify a spatial and temporal scale and downplay the economic role that a species may play, invasive species legislation will continue to be ineffective. This ineffectiveness will cascade down to states that adopt such authority in hopes of achieving similar enumerated environmental goals.

An example of how the vague federal definition of *invasive species* trickles down and affects the states is found in Oregon with European beachgrass. The State of Oregon shares its legislative environmental goals with the federal government.[163] The purpose of Oregon's *invasive* definition is to further the goals enumerated in Executive Order 13112, which include prevention of ecological harm to local areas.[164] However, the vague definition that Oregon uses lends itself to subjective interpretation and therefore inconsistent enforcement of ecologically based regulations.

Oregon defines *invasive species* as "a non-native species whose introduction does, or is likely to, cause economic or environmental harm or harm to human health."[165] This sharing of definitional elements between Oregon and the federal government results in both plainly lacking spatial and temporal reference points, and a strong reference to economic health.[166] However, Oregon attempted to tailor its definition to appeal more towards ecological interests. In Oregon, "[a]n invasive species can be a plant, animal, or any other biologically viable species that enters an ecosystem beyond its native range."[167] Although Oregon adds an apparently spatial phrase, "native range," Oregon does nothing to explicitly define the space over which a species may inhabit—much like the federal definition. This leaves holes open to cater enforcements toward the more economically concerned sections of the definition.

As appealing as economic incentives may be regarding an *invasive* definition exception, invasive species cost the U.S. economy over

---

162 National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. § 4344 (2012); Aquatic Nuisance Prevention and Control Act of 1990, 16 U.S.C. § 4701 (2012); Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999).

163 *See generally* Invasive Species, 64 Fed. Reg. at 6183.

164 *Id.*

165 Or. Invasive Species Council, *supra* note 111.

166 *See generally id.*; Invasive Species, 64 Fed. Reg. at 6183; U.S. Dep't of Agric., *supra* note 75.

167 Or. Invasive Species Council, *supra* note 111.

$120 billion annually.[168] "This amount includes the cost of control, damage to property values, health costs, and other factors."[169] This cost does not consider the ecological damages caused by invasive species due to the difficulty in quantifying them.[170] Therefore, the potential minor economic benefit from an invasive species is unduly outweighed by the heavy impact that they pose of the United States as a whole—financially and ecologically.

According to a comparative study published in Oikos Ecological Journal, in coastal Oregon the relationship between European beachgrass (*Ammophilia arenaria)* and American beachgrass (*Ammophilia breviligulata*) is shifting.[171] The study found that over a twenty-year period, dune locations previously dominated by European beachgrass in the 1930s changed to American beachgrass.[172] "Scientists at Oregon State University have documented a slow but steady takeover by this [American] beach grass."[173] Without a temporal scale to evaluate *invasive*, it is unclear which, if either, of these grasses is the true environmental threat, although it is clear from numerous scientific studies that *A. arenaria* is doing a fabulous job of preventing towns from washing into the ocean.[174]

The weak definitions of *invasive species* fashioned by the federal government and adapted by Oregon do not pinpoint which species the legislation seeks to protect ecosystems from. The added ulterior motive of economic benefits coupled with vague spatial and temporal references do not further the objectives that environmentally based legislation set out to meet. Competing biota are found in every ecosystem worldwide, and without specific spatial and temporal reference points, one cannot differentiate between natural interspecies competition and ones caused by human intervention for economic gain.

---

168 *Id.*

169 *Id.*

170 *Id.*

171 Sally D. Hacker et al., *Subtle Differences in Two Non-Native Congeneric Beach Grasses Significantly Affect Their Colonization, Spread, and Impact*, 121 Oikos 138, 141–42 (2012) (comparing European beachgrass, *Ammophila arenaria*, and American beachgrass, *Ammophila breviligulata*, their interaction with one another, and their biotic and physical impacts on dune ecosystems of the Pacific coast of North America).

172 *Id.* at 139.

173 Hacker, *supra* note 18.

174 *Id.*

Much like Oregon, with its interests in preserving coastal towns, the state of Massachusetts also has a significant sum of money at stake in shoreline preservation.[175] However, in contrast with the vague federal and Oregon definitions, Massachusetts elaborates on the definition of *invasive species* and includes both a specific spatial parameter—within the region—and a temporal condition—"pre-colonial" or 1500 A.D.[176] The Massachusetts definition also provides for a four-step analysis to determine whether something is invasive.[177]

While both federal and Oregon legislation note that a species may not be invasive unless it harms human economic health, Massachusetts allows an exception for seemingly invasive species as well.[178] Massachusetts' exception is based strictly on impacts to the ecosystem.[179] Although European beachgrass is more effective at building large foredunes, the planting of European beachgrass is strictly prohibited in Massachusetts because American beachgrass (*A. breviligulata*), the scientifically indigenous cousin, is the dominant dune building plant along the Massachusetts coastline.[180]

By ignoring the economic aspect of invasive species and applying potential degradation solely to local ecology, Massachusetts values the importance of biodiversity over human finances. This contrasts with the federal exception, where a bypass is given to a species if "societal benefits may greatly exceed any negative effects," despite the enumerated ecological purist views expressed in the Executive Order 13112.[181]

The scientific basis for Massachusetts's regulations is not exclusive to that state. After noting that in order to be invasive a species must first be non-indigenous, a NOAA publication defined *nonindigenous* as an "organism (plant, animal, microbe) found living beyond its historic native range, which is usually taken as the area where it

---

175 *See* Schweitzer, *supra* note 40; Hacker, *supra* note 18.

176 MASS. INVASIVE PLANT ADVISORY GRP., *supra* note 105, at 5–7.

177 *Id.*

178 *See also* Mass. Exec. Office of Energy and Envtl. Affairs, *supra* note 72; DEFINITIONS SUBCOMM. OF THE INVASIVE SPECIES ADVISORY COMM., *supra* note 99, at 1.

179 DEFINITIONS SUBCOMM. OF THE INVASIVE SPECIES ADVISORY COMM., *supra* note 99, *passim*.

180 O'Connell, *supra* note 10, at 8.

181 *Compare* Exec. Order No. 13112, Invasive Species, 64 Fed. Reg. 6183 (Feb. 3, 1999) *with* DEFINITIONS SUBCOMM. OF THE INVASIVE SPECIES ADVISORY COMM., *supra* note 99, at 3.

evolved to its present form."[182] Like the Massachusetts definition of *invasive species*, this definition of *nonindigenous* quantifies a time period. While NOAA supplied this scientifically applicable definition, it has not yet been incorporated into any primary federal authority.

While the controlling federal, Massachusetts, and Oregon definitions of *invasive species* all agree on the negative effects of invasive species and that there should be legislation to stop them, only Massachusetts' definition covers a temporal scale rendering the majority of definitions ineffective.

To effectively combat invasive species universally throughout the United States, controlling regulations must be explicit in their definitions. Without spatial and temporal reference points, exceptions can be made regarding eradication and promotion of certain species for the arbitrary benefit of continued financial exploitation of coastal vistas. Erosion is a constant process and no amount of beach nourishment will stop the inevitable. Further, dismantling of native biodiversity with the introduction of a scientifically invasive species may do more harm than good in the long run. If the federal government adopts their own scientifically supported definition of *invasive species* as supplied by NOAA, states such as Oregon could clearly and strictly enforce invasive policies, thus limiting the amount of species eradication resulting from invasive introduction.

CONCLUSION

The purpose of invasive species legislation is consistent throughout the nation. However, the definition of *invasive species* is not. Therefore, treatment and classification of invasive species is inconsistent throughout the states, especially in regard to coastal dune erosion management. The inconsistent classification and treatment of European beachgrass (*A. arenaria*) in Massachusetts and Oregon illustrate the discrepancy in enforcement of invasive species regulations, whether they be federal or state. This gap in definitional agreement results in an incompatible application of species prohibitions and remediation throughout those two coastal states. If the federal government adopted a scientifically based definition of *invasive* then states would have objective guidance to evaluate if a species is *invasive*. With a clear and concise federal definition, state

182 NAT'L OCEANIC AND ATMOSPHERIC ADMIN., *supra* note 117, at 1.

invasive species regulation would be both enforceable and compatible with national goals.